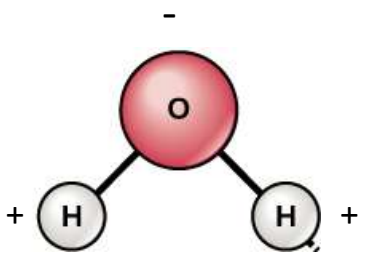
Name _____ Period _____

Water Lab

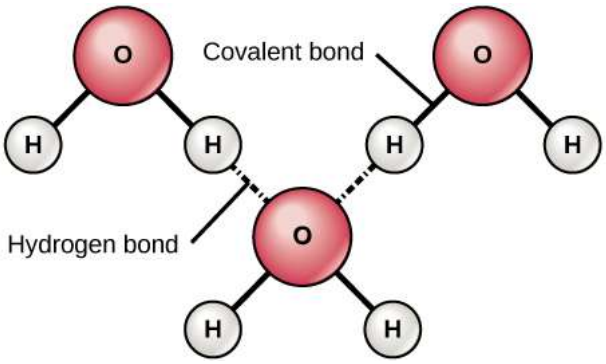
With your group, decide who will perform each task in order to complete the entire lab in this class period. Submit 1 document for a group lab grade.

Part 1 – Water molecule structure & bonding simulation

1. Cut out **four** of the water molecules from the provided template.
2. Place them on a piece of paper and draw the regions of + charge, - charge and hydrogen bonds as shown in the diagram model below.
3. Once you are confident they are arranged correctly, paste them on the paper. Atoms with positive areas only attract atoms with negative areas.



Single water molecule held together by polar covalent bonds



3 water molecules held together by hydrogen bonding

Polar substances always have either a full charge or areas on them with a charge. Oxygen atoms and nitrogen atoms are polar. The areas with nitrogen or oxygen on molecules are polar.

Nonpolar substances do not have charge or have a lot more carbon & hydrogen than oxygen & nitrogen.

Polar substances will attract (dissolve) other polar substances & repel nonpolar substances.

Nonpolar substances will attract (dissolve) other nonpolar substances & repel polar substances.

4. Cut out the **saturated fatty acid** from the provided template.
5. Paste it on a piece of paper and write if it is nonpolar or polar and an explanation for your answer. If it is **polar**, cut out two water molecules and paste them where they would be attracted to the saturated fat. If it is **nonpolar**, write it is nonpolar and an explanation for why water would not be near the saturated fat.
6. Repeat steps 4 & 5 for the **sodium chloride** & the **glucose** from the template provided.

Part 2 – Water Properties

A. Heat of Vaporization

- Substances release heat when they vaporize (evaporate) and is called heat of vaporization.
- **Water releases much more energy than other substance**.
- When liquids evaporate from you skin, energy is released as heat and the loss of heat cools you down. This is called **evaporative cooling**.
- Dip a cotton swab into water, streak onto your skin and time how long it takes to evaporate while blowing air over the liquid.
- Repeat with the alcohol.

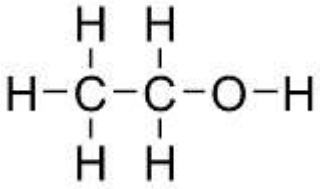
Time for water to evaporate _____ Time for alcohol to evaporate _____

You should notice the water takes longer to evaporate. Remember that hydrogen bonds are like tiny magnets holding polar molecules close together. The structure of alcohol is shown below. Refer to the previous page about polar & nonpolar substances. Water is highly polar but alcohol is nonpolar.

1. Alcohol cannot form many hydrogen bonds with itself. Why does this allow alcohol to evaporate faster than water?

2. Summarize how the polarity of water leads to hydrogen bonding, allowing for evaporative cooling and why this is beneficial for organisms.

Structure of Ethyl Alcohol

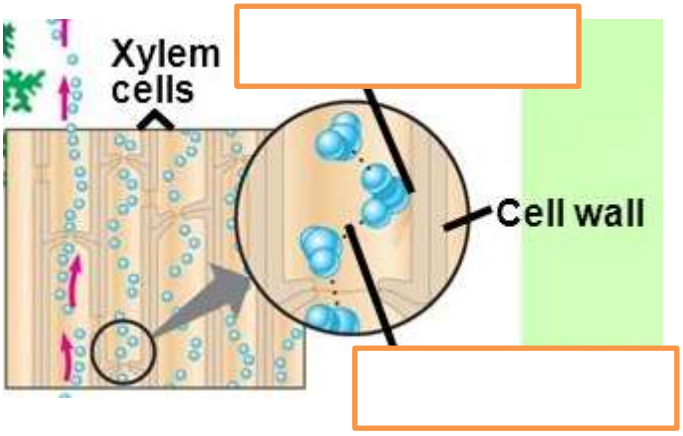


B. Cohesion, Adhesion, Capillary Action & Surface Tension

- **Capillary action** is the movement of a substance up a tube like tree cells called xylem.
- The tree xylem tubes are made of cellulose which is a polar compound & attracts water.
- As water evaporates out of leaves, it creates an upward pulling tension & a constant flow of water is pulled up the entire length of the tree, no matter how tall! This is called **Transpiration**.

1. Review the definition of cohesion & adhesion. Explain how hydrogen bonding will result in cohesion & adhesion inside of tree xylem tubes.

2. On the diagram below of tree trunk xylem cells, fill in the boxes with the words **cohesion** & **adhesion** based on their definitions.



3. Observe the celery sticks in the colored water to see the colored water has moved up the stem against gravity.

- Cohesion & Adhesion also result in water's high surface tension, the ability of its surface to resist breaking under stress. This can be seen by solid objects floating on water.
- A paperclip can be floated on the surface of water if done carefully.
- Attempt to float the paperclip in the dish with water.

4. Explain why the paperclip can float using the terms cohesion, adhesion & surface tension.

C. Density

- Solid ice is less dense than liquid water so it will float.
- Ice forms a crystal structure as the hydrogen bonds freeze in place.
- The hydrogen bonds are usually spaced out making there a lot of empty space between the frozen water molecules.
- This empty space allows the liquid water to form a film underneath the ice and keep the ice floating.
- When solutes like salt or sugar are added, they disrupt the hydrogen bonds in ice and make it more dense.

5. Experiment by adding a water-ice cube to water and then add a salt/water ice cube to water. Describe the results.

6. Explain why oceans and lakes can remain liquid while frozen only at the top. Be sure to use the words <u>density</u> & <u>hydrogen bonding</u> in your answer.

7. Describe 2 reasons that ice floating is important for living things.